

Compact Low Power Avionics for the Europa Lander Concept and Other Missions to Ocean Worlds

Introduction:

- Electronics for Ocean World Landed Missions need to survive extreme cold & radiation:
 - Survive down to -190°C for 33 mission cycles.
 - 300K rad tolerant.
- JPL developed SiP modules:
 - Adaptable to extreme environments.
 - Modularity enables >10X improved board density
 - Distributed or Centralized Topologies



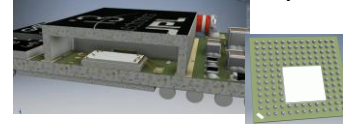
High Density Interconnection (HDI) System in Package (SiP)



Approach:

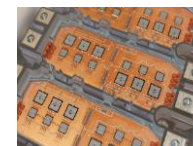
- Focus on cold survivability not cold operation.
- Use cold capable materials.
- Incorporate radiation transport simulation into packaging design.
- Advanced packaging decreases mass and volume which minimize the amount of energy to bring to operating temperature.

Radiation Shielding within System in Package (SiP) Module

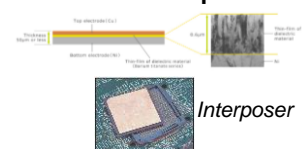


Enhances radiation tolerance.
Allows Distributed Architectures.

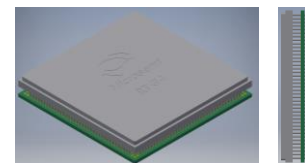
Cold Capable Materials for SiP Part Attach



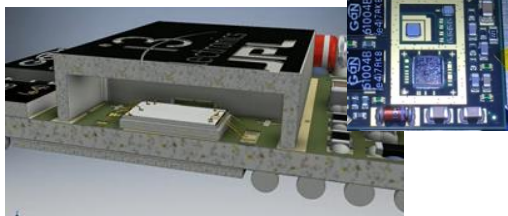
Thin-film Technologies for Built-in Capacitors



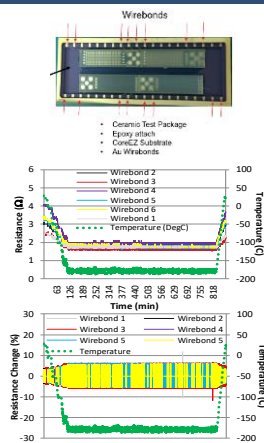
Allows for additional PCB density by eliminating discrete decoupling capacitors on backside of FPGA



Results Summary:



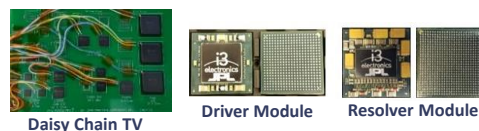
SiP - level radiation shielding design & modeling
Package was designed based on radiation transportation simulation



-184°C to +85°C temperature cycling past 100 cycles

All samples survived the test, validating:

- Cold-adaptable SiP modules
- Ruggedized BGAs
- HDI substrates



Summary

- NASA JPL's new SiP modules :
 - Can survive Europa's extreme cold and radiation environment.
 - Greatly reduces size, weight, and power of spacecraft electronics.
 - Simplifies spacecraft packaging topology.
 - Allow for a flexible approach to packaging topology and implementation.
 - Lowers cost through standardized modules.
 - Enhances the ability to either assemble a distributed or centralized system.
- Illustration of the relative size of a conventionally packaged board (10cm x 15cm) to the same electronics packaged using advanced packaging technology (2.5cm x 2.5cm).

